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PATENT SPECIFICATION

METHOD FOR MANUFACTURING RUBBER PARTS MONOLITHICALLY COMBINED WITH SUBSTRATE

[Field of Invention]

The present invention relates to a method for manufacturing rubber parts monolithically combined with a substrate employed as a sealing member for a fuel cell and the like.

[Related Background Arts]

It has been difficult to form rubber parts monolithically combined with a substrate at predetermined positions precisely by utilizing rubber parts molded beforehand even if grooves for fixing the rubber parts are formed on the substrate, because rubber parts extend and contract to a large extent.

In adhesive rubber parts, when the parts are adhered to a substrate, the parts are tangled with each other. In thin and long cord-like rubber parts, it is difficult to maintain a predetermined peripheral shape formed by the rubber parts because such rubber parts do not have enough rigidity.

In order to avoid such drawbacks, for example, a method for manufacturing seals for fuel cells by irradiating radioactive rays on rubber parts so as to vulcanize the rubber parts without heating, is known (for example, Japanese laid open patent No. 2002-56862).

The above-mentioned manufacturing method is explained as referring to FIG.8.

A reference numeral "5" is a substrate used as a cathode electrode separator, a reference numeral "11" is a mask, a reference numeral "12" is openings on the mask and a reference numeral "13" is rubber layers coated on the substrate.

Rubber containing coating agent is coated on the peripheral regions of the substrate by a screen printing method so as to form rubber containing

layers, which are vulcanized afterward and used in a rubber packing and the like for a seal structure of a fuel cell.

A surface of the separator 5 is covered with the mask 11, the rubber containing coating agent is applied to the separator over the mask several times so that the rubber layers 13 having a predetermined thickness are formed, the layers are vulcanized after solvent in the layers is removed and consequently, thin rubber layers monolithically adhered to the separator 5 are directly formed on the separator.

In other words, unvulcanized rubber is directly applied to the surface of the substrate so as to form the layers which are vulcanized by radioactive rays or the like without heating.

However, in order to form the layers at predetermined positions precisely, this method employ the mask through which the coating agent is applied to the separator, so that it is inevitable that the relatively thin rubber layers are obtained, because a thickness of the layers depends on a thickness of the mask.

The present invention is carried out in view of the problems mentioned above in order to provide a method for manufacturing rubber parts monolithically combined with a substrate, capable of being formed, vulcanized and adhered at a relatively low temperature and being formed in a three-dimensional shape.

[Disclosure of the Invention]

Hereinafter, technical substance of the present invention is disclosed.

(1) A method for manufacturing rubber parts monolithically combined with a substrate at precise positions on the substrate comprising: a placing-molding step to place the substrate in a lower die having a substrate region in which the substrate is placed and to mold the rubber parts by casting unvulcanized rubber material into a space formed between another lower die and an upper die; a positioning step to place the unvulcanized molded rubber parts at desired positions on the substrate by replacing the

another lower die with the lower die having the substrate region; a releasing step to take the substrate and the unvulcanized rubber parts positioned on the substrate out of the die assembly; and a vulcanizing step to vulcanize the unvulcanized rubber parts monolithically combined with the substrate without heating.

(2) A method for manufacturing rubber parts monolithically combined with a substrate at precise positions on the substrate comprising: a placing-molding step to place the substrate in a lower die having a substrate region on which the substrate is placed and to mold the unvulcanized rubber parts by casting into a space formed between another lower die and an upper die; a positioning step to place the unvulcanized molded rubber parts at desired positions on the substrate by replacing the another lower die with the lower die having the substrate region; and a releasing step to take the substrate and the unvulcanized rubber parts positioned on the substrate out of the die assembly.

[Brief Description of the Drawings]

FIG.1 is a cross-sectional view illustrating a rough die assembly employed in an embodiment by the present invention.

FIG.2 is a cross-sectional view illustrating a substrate in a placing step in the embodiment by the present invention.

FIG.3 is a cross-sectional view illustrating the substrate in a molding step.

FIG.4 is a cross-sectional view illustrating the substrate in a die releasing step.

FIG.5 is a cross-sectional view illustrating the substrate on which unvulcanized rubber parts are placed.

FIG.6 is a cross-sectional view illustrating the substrate in a vulcanizing step.

FIG.7 is a cross-sectional view illustrating the substrate monolithically combining with rubber parts.

FIG.8 is a cross-sectional view illustrating a rough arrangement of the conventional art.

[Preferred Embodiment by the Present Invention]

Embodiments by the present invention are explained in detail as referring to drawings.

(Embodiment 1)

Reference characters in FIGs.1 to 7 are defined as follows. "101" is a substrate made of carbon, a carbon plate, resin, a resin sheet, a resin film, metal, metal plate or the like on which parts are placed. "102" is an unvulcanized rubber material. "103" are gates of the unvulcanized rubber material in gate regions 203. "104" are unvulcanized rubber seals. "105" are vulcanized rubber seals monolithically combined with the substrate. "111" is a completed substrate monolithically combining with vulcanized rubber parts. "201" is an upper die. "202" is a lower die. "203" are the gate regions. "204" is a pot region. "205" is a piston. "206" is a substrate region. "207" is cavities. "211" is a press. "221" is a vulcanizing apparatus as one of the vulcanizing means. "231" is a conveying apparatus. "K" is a die assembly.

As shown in FIG.1, the die assembly K employed in the present embodiment comprises the upper die 201 and the lower die 202 as well as the gate regions 203, the pot region 204 and the piston 205 for pressing and molding.

Further the lower die 202 has the substrate region 206 and the upper die 201 has the cavities 207 formed in a desired shape for molding rubber parts.

Here two types of lower dies are employed, one is the lower die 202 having the substrate region in which substrate is placed and the other (not shown) is a die having no substrate regions, but other dimensions are preferably the same as the lower die 202.

In the method for manufacturing rubber parts monolithically combined with the substrate by the present embodiment, the substrate 101 made of a

carbon sheet, a resin sheet or the like is placed on the substrate region 206 in the lower die 202 (the placing step).

Then unvulcanized rubber parts are molded in a die assembly constituted by combining the other lower die having no substrate regions and the upper die 201.

At this step, the other die having no substrate regions 206 is precisely fitted to the upper die 201 and then the piston 205 is pressed by the press so that the rubber material 102 is pressed.

Since the other lower die has no substrate regions 206, only unvulcanized rubber parts having a desired shape are molded, when the rubber material 201 is fed to and fills the cavities 207 of the upper die 201 via the gate regions 203 (a molding step).

In the present embodiment, since the placing step and the molding step do not necessarily carry out in the explained order, combined steps are renamed as a placing-molding step.

Then the other lower die is replaced with the lower die 202 having the substrate region in which the substrate 101 is placed by sliding or the like. The lower die 202 having the substrate region is fitted precisely to the upper die 201 so that the molded rubber material in the cavities 207 are arranged at desired position (an arranging step).

The substrate on which the unvulcanized rubber parts are placed, is taken out of the die assembly (a die releasing step) and vulcanized without heating (a vulcanizing step), thus the rubber parts monolithically combined with the substrate are obtained.

Burrs or dents formed in the rubber seals 104 during separating the gates 103 in the die releasing step can be finished afterward.

Thus, the unvulcanized rubber seals 104 having a desired shape monolithically combined with the substrate 101 are obtained.

The rubber material 102 does not drop onto the substrate 101 by forming the ends of the gate regions 203 quite narrow tips.

In addition, since the gates 103, burrs formed in the pot region of the

die and sprues remain unvulcanized, they can be recycled as the rubber material so that a yield of the rubber material is raised to a large extent.

As shown in FIG.5, the substrate 101 is taken out of the die assembly as keeping the rubber seals being placed on the substrate.

The rubber seals 104 are kept in the molded state by a tension, a viscosity and the like of the rubber material, but they are not firmly bonded with the substrate 101.

In the conventional methods, molding cycles are determined by vulcanizing periods in die assemblies. But, a molding cycle of the present embodiment is determined only by a period for casting the rubber material by arranging the molding step and the vulcanizing step as separated steps, so that a manufacturing period is reduced, consequently, a production rate of the die assembly K is remarkably raised.

The unvulcanized rubber seals 104 are conveyed by the conveyer 231 together with the substrate 101 and vulcanized by irradiating radioactive rays without heating the substrate 101 (the vulcanizing step).

As the vulcanizing step the rubber seals can be bridged by irradiating ultraviolet rays and the like. In the present invention, "vulcanization" is not limited to a step which employs sulfur, but means a bridging step including a narrowly meant vulcanization which employs sulfur. However, since "vulcanization" is commonly and widely interpreted as "bridging" in the art, "vulcanization" is also widely interpreted in the present application.

In this vulcanizing step, the unvulcanized rubber seals 4 are vulcanized so that vulcanized rubber seals 105 are monolithically combined with the substrate 101, thus the rubber parts monolithically combined with the completed substrate 111, which has a desired three-dimensional shape can be obtained.

In other words, since the molding step and the vulcanizing step by the present embodiment are carried out at a relatively low temperature, a shrinkage difference between the rubber part and an object to be combined with can be kept small.

As mentioned above, in the method for manufacturing the rubber parts monolithically combined with the substrate by the present embodiment, since the molding step, the vulcanizing step and the adhering step can be carried out at a relatively low temperature and since rubber parts having a desired shape can be formed precisely at designed positions, the method by the present embodiment can be preferably applied to methods for manufacturing planar products having a large surface area such as a separator with a sealing structure for a fuel cell, a gasket for a hard disk drive and the like.

Further, in the conventional vulcanizations, they are usually carried out at ca. 170℃, while in the present embodiment, parts are molded and vulcanized at an ordinary temperature or the like, so that rubber parts can be formed even on substrates, which are not allowed to heat or which degenerate when heated.

In conventional methods, usually engineering plastics such as PPS, PES, polyimide or the like is selected as a resin for forming parts monolithically combined with the substrate by the vulcanization in view of heat resistance properties of the resin. Consequently, it is inevitable that costs for manufacturing products employing such engineering plastic are remarkably high. On the other hand, plastics such as PE, PP and PS, which can not be employed in the conventional methods, can be employed in the present invention, so that the method by the present invention enable the manufacturing costs to be reduced to a larger extent.

The present invention is not limited to the above-mentioned examples, but can be utilized widely.

In the above-mentioned manufacturing method, a transfer molding is explained as the molding step, the present invention can be also applied to other molding methods such as a compression molding, an injection molding and the like.

When other steps in the compression molding and the injection molding are carried out in the same ways as in the method by the present embodiment, the same effects are attained.

As explained, in addition to the ordinary substrate the present embodiment can provide the method for manufacturing the rubber parts monolithically combined with the substrate, even for the substrate which is not allowed to press or is deformed when pressed.

If the substrate has a heat resistance, a heated vulcanization step can be employed as the vulcanizing step. In this case the precise positioning of the rubber parts may not attained due to expansion or contraction of the rubber parts caused by heating. But the preciseness can be compensated by selecting rubber material and placing the rubber parts in accordance with calculated heat deformations. As described in embodiment 1, embodiment 2 can also attain improved effects to raise a manufacturing capacity by arranging the molding step and the vulcanizing step separately, even when the heated vulcanizing step is employed.

[Possibilities of Industrial Use]

As explained above, the present invention can provide the method for manufacturing the rubber parts having a three-dimensional shape monolithically combining with the substrate, capable of molding, vulcanizing and adhering at a relatively low temperature.

By employing this method, rubber parts can be molded on the substrate which is not allowed to heat or deformed when heated.

In the conventional method the molding cycle is determined by a period for vulcanizing, while the molding cycle of the present invention is determined only by a period for molding the rubber material by arranging the molding step and the vulcanizing step as separated steps. As a result, the manufacturing period is so much reduced that the production capacity of the die assembly is remarkably raised.

Since burrs formed in the pot region of the die and sprues are not vulcanized, they can be recycled as the rubber material so that a yield of the rubber material is raised to a large extent.

In addition, in the conventional molding method, die assemblies are

designed such that the number of sprues is restricted as few as possible in order to raise a yield of the rubber material, but in the present invention die assemblies can be freely designed without considering such restriction.

Since the molding step and the vulcanizing step by the present embodiment are carried out at a relatively low temperature, a shrinkage difference between the rubber parts and an object to be combined with can be kept small so that the anchor effect is maintained after the vulcanization, consequently, the adhering step by the adhesive can be omitted.

Further, rubber parts can be molded on the substrate which is not allowed to press or deformed when pressed.